

Chapter 7B: Update on RECOVER Implementation and Monitoring for the Comprehensive Everglades Restoration Plan

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SUMMARY

This chapter provides an update on Restoration Coordination and Verification (RECOVER) activities documented in Chapter 7 of the *2005 South Florida Environmental Report – Volume I* (McLean et al., 2005). This update is presented in four categories: RECOVER-wide, and Assessment, Evaluation, and Planning and Integration. The activities listed under the RECOVER-wide section fall under two or more mission areas.

RECOVER-wide activities and status are as follows:

- Conceptual ecological models are being published in a special edition of *Wetlands* in December 2005.
- Evaluation and assessment system-wide performance measures have been integrated.
- A new version of the CERP Systemwide Performance Measure document, containing the integrated performance measures, is being developed and should be completed by March 2006.
- The Adaptive Management Strategy is under review and is expected to be completed in early 2006.
- Interim goals and interim targets were completed in February 2005.

Assessment activities and status are as follows:

- Implementation of the CERP Monitoring and Assessment Plan is continuing.
- A final draft of the 2005 Assessment Strategy for the Monitoring and Assessment Plan was distributed for review in September. It includes guidance for the assessment of system responses to restoration on three levels: component, module, and systemwide.

Evaluation activities and status are as follows:

- Several performance measure consistency reviews and evaluations of alternative plans for projects have been conducted.
- Guidance documents are being developed and refined for conducting these reviews and evaluations and for interacting with project teams.
- Predictive performance measures have been and continue to be developed and refined.
- Evaluation tool needs have been identified and the development and refinement of some has begun.
- The development of an ecosystem benefit quantification methodology has begun.

Planning and Integration activities have focused on completing the Initial CERP Update, which was completed in September 2005. Additional information on RECOVER is available on the CERP web site at www.evergladesplan.org/pm/recover/recover.cfm.

RECOVER-WIDE

CONCEPTUAL ECOLOGICAL MODELS

The conceptual ecological models representing South Florida's major wetland physiographic regions and the total system (Ogden et al., 2005a) are being published in a special issue of *Wetlands* that will be released in December 2005. Models have been developed for the following regions: Everglades Ridge and Slough (Ogden, 2005), Southern Marl Prairies (Davis et al., 2005a), Everglades Mangrove Estuaries (Davis et al., 2005b), Big Cypress Regional Ecosystem (Duever, 2005), Biscayne Bay (Browder et al., 2005), Florida Bay (Rudnick et al., 2005), Lake Okeechobee (Havens, 2005), Caloosahatchee Estuary (Barnes, 2005), St. Lucie Estuary and Southern Indian River Lagoon (Sime, 2005), Loxahatchee Watershed (VanArman et al., 2005), and Lake Worth Lagoon (Crigger et al., 2005).

The publication also contains a chapter summarizing the overall development of conceptual ecological models for the South Florida ecosystem and how they are being used (Ogden et al., 2005b). The models have served as the basis for development of natural system performance measures and the monitoring and assessment program. As new information becomes available, models will be revised or new models developed, and the systemwide performance measures and monitoring and assessment protocols will be revised.

CERP SYSTEMWIDE PERFORMANCE MEASURES

RECOVER has developed a set of performance measures that will be used to predict, measure, and assist in assessing CERP's systemwide progress and success. CERP performance measures identify systemwide hydrological, biological, and water quality indicators that are expected to be responsive to CERP implementation. The performance measures were developed in large part from conceptual ecological models and from a review of performance measures used in the Central and Southern Florida (C&SF) Project Comprehensive Review Study (Restudy) (USACE and SFWMD, 1999). For the natural system, performance measures are principally derived from the conceptual ecological models discussed above. For urban and agricultural water

supply and flood protection objectives, performance measures are based on current federal and state law and policy.

Since the distribution of the Draft CERP Systemwide Performance Measures document in June 2004 (RECOVER, 2004a), RECOVER has integrated the evaluation and assessment performance measures to improve the consistency between the predictive and assessment portions of each measure. Other comments received on the draft have also been addressed and RECOVER is currently preparing a new draft. The revised draft will be distributed for review in late 2005 or early 2006.

ADAPTIVE MANAGEMENT PROGRAM

RECOVER has the responsibility to coordinate the development and implementation of a systemwide Adaptive Management Program in support of CERP. RECOVER activities over the past year have focused on the development of an Adaptive Management Strategy, a planning document that contains principles and guidelines for how adaptive management will operate throughout the implementation of CERP.

Adaptive Management Strategy

Adaptive management was recognized in the authorizing legislation and in subsequent regulations for CERP as a critical component of the program. A framework was developed in late 2003; the framework has been the foundation upon which the adaptive management strategy planning document has been developed. Still in draft form, the strategy is expected to be finalized in 2006. The framework consists of a series of phases or “boxes” designed to identify the elements of a comprehensive adaptive management strategy and their linkages (Figure 7B-1).

The CERP Adaptive Management Framework:
Overview

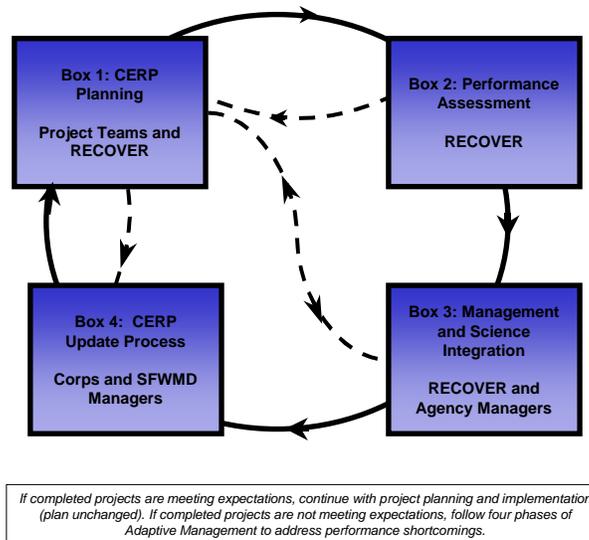


Figure 7B-1. The CERP adaptive management framework.

BOX 1: CERP PLANNING

The goal of Box 1, CERP Planning, is to apply adaptive management principles during CERP planning activities by anticipating uncertainties and incorporating performance-based versatility into project designs and recommended plan improvements. This includes exploring ways to improve plan performance at the project level. As an example of implementing adaptive management principles at the project level, the Water Conservation Area 3 (WCA-3) Decentralization Project has been approved to begin design of a physical model to answer questions surrounding the major ecological uncertainties associated with the role of sheetflow and the targets for restoration of flow, and depths and hydroperiods needed to prevent tree island drowning while restoring the ridge and slough landscape, among others.

BOX 2: PERFORMANCE ASSESSMENT

Box 2 is Performance Assessment. The integrative assessment protocol is described in the final draft of the 2005 Assessment Strategy for the Monitoring and Assessment Plan (RECOVER, 2005a) and is briefly discussed in the Assessment section of this report. The first systemwide report will be prepared in 2006. The procedures outlined in the protocol will be used to assess baseline ecosystem status. The Programmatic Regulations (DOD, 2003) specify that RECOVER shall prepare a technical report not less than every five years that presents an assessment of whether the goals and purposes of the plan are being achieved. The technical report will be used under Box 3 to produce the Assessment Report, as required by the Programmatic Regulations.

BOX 3: MANAGEMENT AND SCIENCE INTEGRATION

Box 3, Management and Science Integration, represents the process of integrating new scientific and technical information into decision-making for CERP. The Assessment Report will provide science-based, solution-oriented options for decision makers to use in deciding upon actions to modify the components or operations of CERP. The Box 3 process is being designed to integrate social, regulatory, and policy perspectives with scientific and technical information, in a timely manner. It must also be flexible enough to handle a potentially broad range of challenges at differing spatial and temporal scales.

BOX 4: CERP UPDATE PROCESS

The final element of the adaptive management framework involves the decision to alter the CERP through adjustments in project plans or operations, or alterations to the sequencing of projects. The goal of Box 4, CERP Update Process, is for decision makers within the sponsoring agencies, U.S. Army Corps of Engineers (USACE) and South Florida Water Management District (SFWMD), to review the Assessment Report and make a determination of what action, if any, should be taken to modify CERP to ensure that the goals and purposes are being met.

INTERIM GOALS AND INTERIM TARGETS

As reported last year, the Water Resources Development Act of 2000 (WRDA 2000) (U.S. Congress, 2000) directs that the Programmatic Regulations (DOD, 2003) establish a process “to ensure the protection of the natural system consistent with the goals and purposes of the Plan...” [Section 601(h)(C)(i)(III)]. The Programmatic Regulations further require that progress toward providing for “other water-related needs” also be evaluated. The vehicle for these

assurances is the establishment of quantitative interim goals and interim targets through which the plan's success may be evaluated incrementally as CERP implementation proceeds.

Due to modeling constraints, it was decided that the initial recommendations for interim goals and interim targets be based upon the modeling performed during the development of CERP. RECOVER delivered its recommendations for interim goals and interim targets to the state of Florida (through the District) and the U.S. departments of the army and interior in February 2005 (RECOVER, 2005b). The three parties have been negotiating the Interim Goals Agreement, which is not a RECOVER responsibility. An Interim Targets Agreement between the state and the army is also under development.

ASSESSMENT

CERP MONITORING AND ASSESSMENT PLAN

The CERP Monitoring and Assessment Plan: Part 1 Monitoring and Supporting Research (MAP) (RECOVER, 2004b) was published in January 2004, and is currently being implemented. **Table 7B-1** lists all MAP monitoring components along with the section of the MAP that describes the projects and their status. **Table 7B-2** provides a similar list for key uncertainties and supporting research projects described in the MAP. The second part of the plan containing assessment protocols is discussed below.

Some of these are existing projects being conducted throughout the District, but are now being used in RECOVER's systemwide monitoring and assessment effort. Collection of critical biological data has begun for key indicator species that are critical linkages and attributes in the conceptual ecological models. Statistical analysis and results from the first five years of monitoring and associated studies will allow RECOVER to fine tune the long-term monitoring to be able to best assess the effects of CERP on the ecosystem through 2050. Some of these projects are summarized in the subsections following the tables. The newly implemented projects are described below; neither the existing projects nor projects that have not yet been implemented are described.

Table 7B-1. A list of Monitoring and Assessment Plan (MAP) components including MAP section and status.

MAP Component	MAP Section	Status
GREATER EVERGLADES WETLANDS		
Fish Sampling Methods Testing in Forested Wetlands	3.1.3.10	Underway: SFWMD
Aquatic Fauna Regional Populations	3.1.3.10	Underway: SFWMD
Amphibian Communities as Restoration Indicators	3.1.3.10	To be implemented in FY2006: USACE
Dry Season Aquatic Fauna Concentrations	3.1.3.11	Underway: SFWMD
Wading Bird Foraging, Distribution, and Abundance	3.1.3.12	Underway (MOD Waters project)
Wading Bird Nesting Colony Location, Size, and Timing	3.1.3.12	Underway: USACE
Successful Snail Kite Nesting in Greater Everglades	3.1.3.13	To be implemented in FY2006: USACE

MAP Component	MAP Section	Status
Wood Stork and Roseate Spoonbill Nesting	3.1.3.14	Underway: USACE
American Alligator Distribution, Size, and Nesting	3.1.3.15	Underway: USACE
American Crocodile Juvenile Growth and Survival	3.1.3.16	Underway: USACE
Fish Sampling Methods Testing in Forested Wetlands	3.1.3.10	Underway: SFWMD
Interior Gradients of Flow	3.1.3.1	Planning underway
Regional Distribution of Soil Nutrients	3.1.3.2	Underway: SFWMD lead
Coastal Gradients: Salinity, Flow and Nutrients	3.1.3.3	Underway: USGS lead
Systemwide Vegetation Mapping	3.1.3.4	Contract negotiation underway
Landscape Pattern: Marl Prairie/Slough Gradients	3.1.3.5	Underway: USACE
Landscape Pattern: Ridge, Slough, Tree Islands	3.1.3.6	To be implemented in FY2006: SFWMD
Landscape Pattern: Tidal Creek Delineation	3.1.3.7	Complete: SFWMD
Mangrove Forest Soil Accretion	3.1.3.9	To be implemented in FY2006: USACE
Periphyton Mat Cover and Composition	3.1.3.8	Underway: SFWMD
SOUTHERN ESTUARIES		
Water Quality and Phytoplankton Monitoring Network	3.2.3.1	Underway: SFWMD (Non-RECOVER)
Salinity Monitoring Network	3.2.3.2	Underway: National Park Service, SFWMD, Miami-Dade Department of Environmental Resource Management (DERM)
South Florida Fish Habitat Assessment Network	3.2.3.4	Underway: SFWMD
Seagrass Fish and Invertebrate Assessment Network	3.2.3.5	Underway: NOAA/USACE
Shoreline Fish Community Visual Assessment	3.2.3.6	Underway: NOAA/USACE
Juvenile Spotted Seatrout Monitoring in Florida Bay	3.2.3.7	Underway: NOAA/USACE
Large-Scale Submerged Aquatic Vegetation Remote Sensing	3.2.3.4	Underway: SFWMD
NORTHERN ESTUARIES		
Salinity Monitoring Network	3.3.3.1	Underway
Water Quality and Phytoplankton Monitoring Network	3.3.3.2	Partially implemented; no phytoplankton monitoring currently
Submerged Aquatic Vegetation (SAV) Mapping from Aerial Photography	3.3.3.3	Underway in all but Lake Worth Lagoon
SAV Monitoring for Caloosahatchee Estuary	3.3.3.4	Underway
SAV Transects/Visual Surveys for St. Lucie Estuary/Indian River Lagoon, Lake Worth Lagoon, and Loxahatchee River Estuary	3.3.3.5	Underway in all estuaries except Lake Worth Lagoon
Oyster Monitoring Network	3.3.3.6	Underway
Juvenile Fish Community Monitoring Network (Caloosahatchee Estuary, St. Lucie Estuary and Indian River Lagoon)	3.3.3.7	Underway in Caloosahatchee Estuary; pilot project for St. Lucie Estuary/Indian River Lagoon with proposed FY2006 start
Benthic Macroinvertebrate Monitoring (St. Lucie Estuary, Loxahatchee River Estuary)	3.3.3.8	Underway in St. Lucie Estuary/Indian River Lagoon, planned FY2006 start in Loxahatchee Estuary

Table 7B-2. A List of key uncertainties and supporting research projects from the MAP including MAP section and status.

Key Uncertainties and Supporting Research	MAP Section	Status
GREATER EVERGLADES WETLANDS		
Coastal Wetland and Bern Systems: Sea Level and CERP Influences	3.1.4.1	No funding proposed in FY2006
Tidal and Freshwater Creek Dynamics: Sea Level and CERP Influences	3.1.4.2	No funding proposed in FY2006
Productivity in Coastal Ecotones: Sea Level and CERP Influences	3.1.4.3	No funding proposed in FY2006
Ridge and Slough Landscape Pattern Sustainability	3.1.4.4	To be implemented in FY2006: SFWMD
Technology Development: NASA Vegetation Mapping	3.1.4.5	No funding proposed in FY2006
Crayfish Population Dynamics	3.1.4.6	Underway: SFWMD
Aquatic Refugia: Coastal Ecotone, Alligator Holes and Solution Holes	3.1.4.7	To be implemented in FY2006: USACE
Ecological Effects of Canals and other Artificial Deep Water Habitats	3.1.4.8	To be implemented in FY2006: USACE
Synthesis of Wading Bird Surveys 1985-2001	3.1.4.9	Underway: SFWMD
Sub-lethal Effects of Contaminants of Wading Bird Reproductions	3.1.4.10	Underway: FDEP, USACE
SOUTHERN ESTUARIES		
Florida Bay Sediment Dynamics: Sea Level and CERP Influence	3.2.4.1	No proposed start date as of 6/05
Measurement of Submarine Groundwater Discharge to Biscayne Bay	3.2.4.2	No proposed start date as of 6/05
Biological Availability of Organic Nitrogen in Florida Bay	3.2.4.3	Underway: SFWMD
Present and Past Distribution of Oysters in South Florida Coastal Complex	3.2.4.4	Underway: CESI
Factors Controlling Epibenthic Communities of Near-Shore Biscayne Bay	3.2.4.5	No proposed start date as of 6/05
Salinity Relationships of Epifaunal Species of Near-Shore Biscayne Bay	3.2.4.6	No proposed start date as of 6/05
Empirical Research of Epifaunal Species of Near-Shore Biscayne Bay	3.2.4.7	No proposed start date as of 6/05
Causal Factors of Fish Abnormalities in Biscayne Bay	3.2.4.8	No proposed start date as of 6/05
Bottlenose Dolphin Health Assessment in Biscayne Bay	3.2.4.9	No proposed start date as of 6/05
Manatee Abundance and Distribution Relative to Freshwater Inputs	3.2.4.10	No proposed start date as of 6/05
NORTHERN ESTUARIES		
Reconnaissance Study of Caloosahatchee	3.3.4.1	Complete
Fish Health and Pathology in the St. Lucie Estuary	3.3.4.2	Underway funded by state grants
Bottlenose Dolphin Health Assessment in St. Lucie Estuary	3.3.4.3	No proposed start date
Manatee Abundance and Distribution Relative to Changes in Freshwater Flows and Seagrass Distribution as a Result of Implementation of CERP Projects	3.3.4.4	No proposed start date

Greater Everglades Wetlands

HIGH RESOLUTION VEGETATION MAPPING

Landscape/vegetation monitoring components are being implemented to supplement existing vegetation maps. The five-year, high resolution (0.25-hectare grid) vegetation maps will capture changes in vegetation type (category), especially when changes arise at large spatial extents. Currently, Water Conservation Area 1 (WCA-1) maps have been completed in-house within the Everglades Division of the District. A contract began in summer 2005 for the photo interpretation of vegetation maps within Everglades National Park (ENP or Park), Big Cypress National Preserve, Corbett-Dupuis Wildlife Management areas, and the southwestern Florida coast. Although the total map will not be available until 2010, a web site will be constructed where map sections will be viewable as they are completed and accepted.

TRANSECT AND SENTINEL SITE EXPERIMENTAL DESIGN

As a follow up to the original stratified random sampling design, a group of experts in the field of experimental design were convened at a workshop in January 2005. After reviewing the current design in place for wet season throw-trap sampling, the group proposed some modifications to design. These modifications include removing the restrictive landscape subunit (LSU) boundaries of the previous sampling design. The new design will allow the principle investigator to redraw the LSU boundaries, and then use the stratified randomization design to pick sampling points. This eliminates the "edge effect" of all the previously drawn LSUs; edges of LSUs were excluded from areas to be used for randomized point selection. The other flexibility of this design is to allow redrawing of LSUs as the landscape changes under CERP implementation.

A design for sentinel site sampling was also proposed in the final report. This involves the establishment of two long transects crossing Shark River Slough and into the adjacent marl prairie and rocky glades. Along these transects, species composition and coverage classes would be quantified every year in 10 meter-by-10 meter plots every 100 or 1,000 meters. Several smaller transects were also proposed along ecotones within the Greater Everglades Wetlands. The vegetation plots along these transects would allow the documentation of changes in vegetative composition over time at a given point (but this cannot be inferred across the region), and will also allow for finer-grain identification of mixed plant classes that the 0.25-hectare vegetation mapping would not be able to detect.

COASTAL GRADIENTS OF FLOW AND WATER QUALITY

The Coastal Gradients of Flow and Water Quality project, started in Fiscal Year 2003 (FY2003), and completed in FY2004, included the installation and instrumentation of ten new flow and three new nutrient monitoring stations. These stations were all operational as of October 2004. These stations complimented an existing U.S. Geological Survey (USGS) monitoring network by filling in critical gaps. The areas chosen for instrumentation will be influenced by the restoration of sheetflow as CERP proceeds; therefore, the data provided by these stations will enable the creation of a reference state. The total cost of the project was cooperatively cost-shared by the USGS and the District. Data from these stations is also being cooperatively shared via the South Florida Information Access (SOFIA) site. Future funding for the station maintenance and operations will be cost shared by the USGS and USACE.

TIDAL CREEK GEOMORPHIC SURVEY IN SOUTHWEST EVERGLADES

The Tidal Creek Geomorphic Survey in Southwest Everglades project's objective was to test technology used to define bathymetry of tidal creeks in the southwest Everglades. The tidal creeks used for initial bathymetric survey were Shark River and Trout Creek. This project used state-of-the-art technology including Shallow and Nearshore Depth Survey (SANDS) and Experimental Advanced Airborne Research (EAARL), and SUBMETRIX swath bathymetry. The data set produced by these three technologies concluded that the SANDS system substantially exceeds current USACE Minimum Performance Standards. The EAARL and SUBMETRIX systems did not meet these standards. Currently, working hypotheses for the coastal regions of southern Florida are under revision; these hypotheses will direct if further research funds will be allocated to tidal creek bathymetry in future years.

GREATER EVERGLADES TREE ISLAND CHARACTERIZATION

The major objective of the Greater Everglades Tree Island Characterization monitoring is to obtain annual hydrographs for each tree island located within WCA-3A and -3B and create a tree island height distribution map. This project is an extension of a collaborative effort with the mapping and surveying division of the Florida Department of Environmental Protection (FDEP). The objective of the collaborative effort between FDEP and District, completed at the end of May 2005, was to establish 31 vertical ground elevation benchmarks in WCA-3. Accordingly, measurements of surface and peat elevations will provide information that will be used to determine accurate hydroperiod regimes of tree islands located in WCA-3A and -3B. Similarly, reliable tree island water depths could be used to calibrate and process information for the Everglades Landscape Model (ELM), the Everglades Landscape Vegetation Model (ELVM), and the Across Trophic Level System Simulation (ATLSS) models. This project is discussed in more detail under the subheading "Benchmarks in WCA-3" in Chapter 6: Ecology of the Everglades Protection Area by Sklar et al.

Now that the benchmarks are in place, the project will produce annual hydrographs for tree islands that are within a two to three-mile radius of a benchmark. The field work involves the measurement of water depth at the closest of 31 benchmarks and at one point located at the edge of the tree island, which will be used as a benchmark, to measure surface or ground water depth, using at least 10 points, around the head of the tree island.

The second objective of this characterization study is to conduct a qualitative synoptic survey of the plant community structure for each tree island. The contractor will note the presence of the invasive exotic Old World climbing fern (*Lygodium mircophyllum*), endangered plants and animals, and any other exotic species.

DRY SEASON FISH CONCENTRATION STUDIES

A study to test a patch-prey availability hypothesis (RECOVER, 2004b) was initiated with the onset of the 2003–2004 dry season. This research effort is investigating the availability of forage fishes and other prey in drying pools of water, and how wading birds utilize these drying pools on a landscape scale. The initial year (spring 2004) was spent testing sampling bias and effects for randomized versus chosen sites within the primary sampling unit. The conclusion was that the investigators were less likely to choose a "good" prey patch than would be encountered with randomized throw trap sampling. Initial data concludes that very slight topographic depressions, such as trails left by alligator movement, may be critical for prey concentration. In the second field season, (spring 2005), heavy spring rainfall kept reversing water levels to the

extent that it was difficult to measure concentration effects. However, this lack of prey concentration was coupled with widespread nest abandonment by wood storks (*Mycteria americana*), white ibis (*Eudocimus albus*), and other wading birds.

CRAYFISH POPULATION DYNAMICS AND HYDROLOGICAL INFLUENCES

Through indirect results of research and monitoring on wading birds and fish, native crayfish (*Procambarus alleni* and *P. fallax*) are now recognized as critical ecosystem components in the Greater Everglades Wetlands, although little is known about their basic life history characteristics or relationship to the hydrology of the Everglades. This study, initiated in early summer 2004, is being conducted to determine baseline crayfish populations and their life history linkages with hydrology, and their role in wading bird nesting success. Currently, field collections using the stratified random design are being used to conduct a systemwide census to establish baseline biomass and distribution conditions for both the native crayfish species. In spring 2005, an experimental study was initiated using concrete mesocosms to test growth studies of both species.

GREATER EVERGLADES AQUATIC FAUNA POPULATIONS AND PERIPHYTON MAT COVER AND COMPOSITION

Wet season marsh fish and macroinvertebrates population and periphyton production and community composition data are being gathered across the Greater Everglades Wetlands ecosystem. The current condition of these populations will be established allowing scientists to detect changes and trends in aquatic fauna and periphyton population structures during CERP implementation. Aquatic fauna and periphyton will be sampled at sites selected using a stratified random design. Information gathered about the population dynamics of these aquatic fauna and periphyton communities will be used (1) as input for predictive models, and (2) to interpret the relationship between wading birds and aquatic fauna populations and the periphyton community structure and composition. Understanding this relationship between the upper, primary and secondary trophic levels will be used to assess CERP's performance.

FORESTED WETLAND FISH SAMPLING METHODOLOGY

One of the results of the Preliminary Baseline Characterization of Fish Populations Project, completed in early spring 2004, was that the forested wetlands of South Florida could not be sampled in the same way as the freshwater emergent marshes. Forested wetlands cover hundreds of thousands of hectares of South Florida. The mangrove swamps of southern and southwestern ENP represent one of the largest continuous mangrove forests on earth. The Big Cypress Swamp ecosystem covers a large area of interior southwestern Florida, and is comprised of several types of cypress habitats termed domes, strands, and dwarf cypress (Duever et al., 1986; Ewel, 1990).

Both systems are important pieces in the hydrological system of the Greater Everglades Wetlands region, yet both have been poorly studied compared with the Everglades gramminoid wetlands. These forested wetlands formerly functioned as critical feeding and nesting sites for wading birds, whose populations have declined precipitously in coincidence with changes to the hydrology of the region. Anthropogenic changes have affected the natural hydrologic variability of environmental conditions through the construction of canals and levees that can either act to drain or flood wetlands, which is hypothesized to have negatively affected the production and availability of fish prey for the birds.

A major target of restoration is the reestablishment of the natural hydrological conditions in these wetlands. The Big Cypress and mangrove ecosystems have been affected by all of these anthropogenic activities, yet the effects are unclear because of the lack of quantitative data. Anecdotal and a few qualitative/quantitative evidences suggest that the standing stocks of aquatic animals and their population sizes have been affected negatively by altered hydrology.

To detect changes in natural and artificial habitats resulting from these restoration programs, quantitative baseline data on the constituent aquatic communities and their ecology are needed before, during, and after restoration actions. Baseline data collections are intended to document animal community composition, ecology, and dynamics, because those animals support many of the predatory species, especially alligators and wading birds.

Forested wetlands present a particularly difficult challenge when attempting to quantitatively sample aquatic fauna. Traditional fishery methods of towing trawls, pulling seines, or visual censuses simply do not work. Fixed-location, bottomless enclosure nets that either drop from above or are pulled up from below have shown considerable promise (Lorenz et al., 1997; McIvor and Silverman, 2003). However, these have never been cross-calibrated for gear bias and recovery efficiency in such habitats.

This activity, funded by the USACE, started in late summer 2004, will enhance the ongoing fish work in Big Cypress Swamp, ENP, and the southwest coast of Florida by complementing it with field experiments to determine gear bias, and efficiency, and an adequate amount of sampling events, replication, and habitat specific sampling for their effect on variance and the ability to detect change due to changes in hydrology.

SYNTHESIS OF SYSTEMATIC RECONNAISSANCE FLIGHTS

It is estimated that the number of wading bird nests in the Everglades has decreased by 70 percent since the 1930s (Crozier and Gawlik, in prep). However, wading bird trends appear to be species specific. The number of wood stork and white ibis nests in the Everglades has decreased by 78 and 87 percent, respectively, since the 1930s. However, the number of great egret (*Ardea alba*) and great blue heron (*A. herodias*) nests appears to have increased over the past 50 years. The species specific population changes emphasize the need to examine individual species and their hydrologic requirements.

Along with these changes in population numbers has been a substantial shift in the location of wading bird colonies in the Everglades since the 1930s (Kushlan and White, 1977; Ogden, 1994). The large “super colonies” that once lined the coastal mangrove fringe in the southern Everglades have been replaced by smaller colonies located in the northern freshwater portions of the Everglades. These changes in the wading bird community have coincided with the construction of massive water control works for flood control and water supply in South Florida that have resulted in changing the hydroperiod, sheetflow, recession rate, and water depth within different parts of the system.

The evidence points to changes in the availability of food as the cause of these alterations in the wading bird community. It is believed that water management activities have changed the hydrology and decreased the extent of the Everglades reducing the availability of prey for wading birds, reducing their feeding success and ultimately their reproductive output. Prey availability may be reduced by a decrease in the density of prey and/or the vulnerability of prey in foraging areas.

The main objectives of this study are to (1) determine the relative contribution of short- and long-term effects of hydrologic stressors and landscape variables on the variation and trends in wading bird feeding patterns and population sizes observed over the past 15 years, (2) develop a wading bird performance measure for CERP based on relationships between wading bird spatial distributions and annual nesting effort, and (3) evaluate Systematic Reconnaissance Flights (SRF) as a tool for wading bird monitoring.

WADING BIRD NESTING COLONY LOCATION, SIZE, AND TIMING; WOOD STORK AND ROSEATE SPOONBILL NESTING SUCCESS

The three-year Wading Bird Nesting Colony Location, Size and Timing; Wood Stork and Roseate Spoonbill Nesting Success project is designed to continue and enhance monitoring of populations of breeding wading birds in the South Florida ecosystem. Wading birds are a dominant predator in the Greater Everglades Wetlands region and represent a large part of the vertebrate biomass; breeding population responses are considered to be integrative and reflective of many aspects of the wetland habitat.

Success and productivity of breeding is also predicted to improve, especially for two species (wood storks and roseate spoonbills, *Ajaia ajaja*) specifically for which past information is available. This effort is continuing to build on an existing database of reproductive success and productivity information extending back to the 1960s for wood storks and to the 1930s for spoonbills. This same database continues a large and fruitful wading bird dataset, which has already served as an early warning of the collapse of ecosystem function, the widespread contamination of the wetland biota with mercury, and the critical functions provided by droughts.

The locations, timing, and numbers of the wading bird colonies throughout the system are critical to evaluate the trophic hypothesis upon which restoration is centered. With reference to wading birds, this central hypothesis states that more appropriate hydrology will generate both more dense populations of fishes and macroinvertebrates, and also create better conditions for making these prey available. In turn, these enhanced and more reliable foraging opportunities will result in more wading birds feeding and more of them breeding. Nesting will be restored in the coastal areas. Storks and spoonbills clearly nested in large numbers in the coastal region and their reproduction can serve as a potent bell-weather of change in that region. Without information on the numbers, locations, timing, and success of birds nesting, it will be very difficult to evaluate this string of predictions.

SUB-LETHAL EFFECTS OF CONTAMINANTS ON WADING BIRD REPRODUCTION

Restoration of wading bird reproduction has been a centerpiece of the argument for restoring hydrology in the Everglades. However, the current nesting populations demonstrate reproductive anomalies that appear also to be consistent with contaminant effects. While reproductive failure is likely related to a hydrology-mediated problem with the production and availability of fishes, contaminants remain an important competing explanation.

Therefore, while hydrologic degradation may have been a primary cause of population and nesting declines, reproductive impairment due to contaminants may also be operating in the current, more polluted South Florida environment. Our lack of knowledge about the levels and specific effects of contaminants remains a key uncertainty in our ability to predict reproductive responses of wading birds.

Two major uncertainties have been identified in resolving effects of contaminants on wading bird reproduction in the Everglades. First, is the identification of potential contaminants that might be of risk to the birds. Second, the effects of most contaminants on wading bird reproduction are poorly known, and the only useful information is that contaminants can have effects on reproduction in other bird groups.

The Sub-lethal Effects of Contaminants on Wading Bird Reproduction Project was initiated in early 2005. Phase 1 has consisted of constructing an experimental aviary and capturing young white ibis to rear in a controlled environment prior to dosing them with mercury. Now that a population of captive birds has been established, Phase 2 will consist of conducting aviary studies to experimentally investigate the effect of ecologically relevant concentrations of contaminants on willingness to breed, reproductive success, and other sub-lethal effects such as susceptibility to disease, parental behavior, endocrinology, and foraging behavior.

Aviary studies are conducted on breeding groups to include individual variation in stresses (planned food shortages, effects of normal dominance, disease) so that the mechanisms and patterns by which contaminant effects are manifested in the field can be inferred with confidence.

AMERICAN ALLIGATOR DISTRIBUTION, SIZE, NESTING, AND HOLE OCCUPANCY

Breeding American alligator (*Alligator mississippiensis*) distributions within the Greater Everglades Wetlands have been reduced since the drainage system of the CS&F Project was initiated. The alligators have moved out of the marl prairies as they became increasingly overdrained and into the canal system. It is hypothesized and some preliminary work suggests that alligators are critical components in maintaining the structure of the Greater Everglades Wetlands landscape, ultimately affecting the secondary trophic level.

At present, a network of alligator night surveys has been established and surveys have been conducted since 2001 to assess alligator distribution and body condition throughout the Greater Everglades Wetlands ecosystem. This network was designed to satisfy the requirements for monitoring changes in alligator populations over relatively short time periods as a result of restoration. Critical Ecosystems Studies Initiative (CESI) funded the development of the network and procedures.

The return of reproducing alligator populations to the southern marl prairie and the mangrove estuaries, while maintaining alligator nesting in Shark River Slough, will be monitored by systematic reconnaissance flights in July of each year. Occupancy rate of alligator holes, with a hole of 75–100 percent occupation, and an increase in the number and distribution of alligator holes in areas of low density will be monitored by mapping alligator holes in combination with occupancy checks. These alligator holes will be mapped every three years in the regions where the secondary trophic level populations are also being monitored on a landscape scale.

AMERICAN CROCODILE JUVENILE GROWTH AND SURVIVAL

The American crocodile (*Crocodylus acutus*) thrives in healthy estuarine environments and, in particular, is dependent on freshwater deliveries (Mazzotti, 1999). In this regard, crocodiles can be used to evaluate restoration alternatives and to set success criteria for Florida and Biscayne Bays. Water management practices have changed natural patterns of freshwater inflow to Florida and Biscayne Bays. Less fresh water in Florida Bay suggests that crocodiles not only grow more

slowly, but also have to disperse farther. Both factors negatively impact survival and the suitability of shoreline and island nest sites.

In northeastern Florida Bay, the combination of saline water and long distance dispersal appears to limit hatchling growth and survival. In the lab, crocodiles grow best when the salinity is less than 50 percent seawater (18 parts per thousand, or ppt) and they lose mass when exposed to salinity greater than 40 ppt unless fresh water is provided periodically (Mazzotti, 1983). In the field, lower growth and survival rates have been associated with higher salinities (Mazzotti and Cherkiss, 2002). The working hypothesis for this relationship is that crocodiles that grow faster are also in better condition (relatively fatter) than crocodiles that grow more slowly. The relative distribution and abundance of crocodiles also reflects these salinity patterns. Within an area, most crocodiles occur at the lower end of the available salinity gradient (Mazzotti, 1983; Brandt et al., 1995; Mazzotti and Cherkiss, 2002).

Most sightings of crocodiles are in water of less than 20 ppt, and most sightings of crocodiles in more saline water are females attending nest sites or juveniles presumably avoiding adults foraging. It is believed that the restriction of freshwater flow into an estuary will decrease the relative density of crocodiles and that restoring or enhancing freshwater flow would increase relative density.

The increase in crocodiles and crocodile nests on the freshwater side of Buttonwood Canal after it was plugged provides anecdotal support for this hypothesis. Growth and survival of crocodiles has been identified as a performance measure for CERP.

American crocodile surveys will be conducted using methodologies described in Mazzotti and Cherkiss (2002). Surveys for crocodile nests are conducted April through August in Biscayne and Florida Bays. Nests are monitored through the incubation, and the hatchlings are captured, measured, and marked upon emergence. Surveys and captures of juvenile crocodiles will be conducted four times a year in the same areas. All animals recaptured will be weighed, measured, sexed, and marked. Salinity and temperature is also collected at the capture sites.

Southern and Northern Estuaries

OYSTER MONITORING IN SOUTHEAST FLORIDA ESTUARIES

The main objective of the Oyster Monitoring in Southeast Florida Estuaries project is to implement a long-term monitoring program for American oysters (*Crassostrea virginica*) in southeastern Florida. Four aspects of oyster ecology will be monitored: (1) spatial and size distribution patterns of adult oysters, (2) distribution and frequency patterns of oyster diseases resulting from infection by pathogens [*Perkinsus marinus* (“dermo”) and *Haplosporidium nelsoni* (MSX)], (3) oyster reproduction and recruitment, and (4) juvenile oyster growth and survival.

Oyster beds provide important habitat for numerous organisms and are strong indicators of a healthy estuary. The change in spatial extent and health of oyster beds in southeastern Florida estuaries are a key performance measure that will help assess CERP’s success. Data generated and contained in project reports will be analyzed to determine if the health and spatial extent of oysters is improving with time. Maps of oyster location, density, and health will also be a key product. Monitoring in the Caloosahatchee Estuary began in 2003. Monitoring in St. Lucie Estuary, Loxahatchee Estuary, Lake Worth Lagoon, and Biscayne Bay began in November 2004.

SOUTH FLORIDA FISHERIES HABITAT ASSESSMENT

The goal of the South Florida Fisheries Habitat Assessment is to provide information for spatial assessment and resolution of interannual variability in seagrass and macro-algal communities and to establish a baseline to monitor responses of these communities to water management alterations associated with CERP activities. The status and trends of seagrass distribution, abundance, and reproduction will be documented. Process-oriented data, such as photosynthetic quantum yields and epiphyte loads, will be provided.

Resource managers will be able to use these data to address ecosystem response issues on a real-time basis, and to weigh alternative restoration options. Specific objectives of the project are to (1) develop a basic understanding of the relationships among salinity, water quality, and seagrass species distribution and abundance in South Florida, (2) provide data to separate anthropogenically induced changes from natural system variation, and (3) verify model predictions on species and ecosystem-level responses to system perturbation. RECOVER monitoring for this project, which greatly expanded the scope of a long-term effort, began in May 2004.

SOUTHERN ESTUARIES DISSOLVED ORGANIC MATTER FATE AND EFFECT

Everglades restoration has generally focused on the loading, fate, and effects of phosphorus because the Everglades are known to be limited by phosphorus availability. However, primary production in estuaries and other coastal marine ecosystems generally is commonly limited by the availability of nitrogen, and this may be the case in western and central Florida Bay.

One hypothesis of concern to the District is that nitrogen loading to the bay from the Everglades may increase with increasing freshwater flow causing stimulation of algal blooms (Brand, 2002; CROGEE, 2002). Some evidence is consistent with this hypothesis.

Ongoing research is being conducted to measure the fate and effect of nitrogen from the Everglades in Florida Bay. Water quality modeling (part of CERP's Florida Bay and Florida Keys Feasibility Study) will utilize results from this research to assess CERP impacts on Florida Bay's water quality and provide restoration recommendations to CERP.

CALOOSAHATCHEE ESTUARY SUBMERGED AQUATIC VEGETATION MONITORING

The premise of CERP is that restoring hydrology in the Caloosahatchee Estuary will improve spatial and structural characteristics of submerged plant communities. Submerged aquatic vegetation (SAV) beds provide important habitat for numerous organisms and are indicators of a healthy estuary.

The objective of SAV monitoring in the Caloosahatchee Estuary is to determine if the restoration of beneficial patterns of freshwater inflow, salinity, and water quality to the Caloosahatchee Estuary will achieve the expected distribution, community structure, and viability of SAV beds.

This monitoring will provide the scientific basis for quantifying the success of these projects. During the first year of the project (2004), SAV was monitored in the upper and lower Caloosahatchee River and San Carlos Bay.

CALOOSAHATCHEE ESTUARY SUBMERGED AQUATIC VEGETATION MAPPING FROM AERIAL PHOTOGRAPHY

Caloosahatchee Estuary SAV is being monitored through the use of mapping from aerial photography. The first mapping was completed in 1999, and another survey was done in 2003. Geographic Information System (GIS) maps are produced by interpreting these photos. Subsequent mapping approximately every two years will allow evaluation of SAV acreage trends and distribution changes.

CALOOSAHATCHEE RIVER/CHARLOTTE HARBOR JUVENILE FISHERIES MONITORING

The main objective of the Caloosahatchee River/Charlotte Harbor juvenile fisheries monitoring program is to (1) address the critical need for effective assessment techniques for an array of species and sizes of fish and selected invertebrates, (2) provide timely information for use in management plans, and (3) monitor trends in the relative abundance of fish in a variety of estuarine and marine systems throughout South Florida.

In addition to the primary goals of describing long-term trends in fishery abundance and size distribution related to fishery management, this data has been useful for preparing species inventories for major estuaries throughout Florida, documenting habitat and dietary needs for a variety of estuarine fish and invertebrates, displaying geographic information on fish distribution and primary nursery areas, and assessing the implications of water resource management to estuarine fish communities.

Expansion of this holistic, multi-gear, long-term monitoring program into southern Charlotte Harbor will provide South Florida resource managers with high quality information on fish communities that may be useful when gauging the effects of natural and anthropogenic disturbances, restoration projects affecting fish habitat, and changes in water quality and quantity.

Principal investigators from both the west and east coasts have been collaborating this past spring and summer on test different methods of fisheries monitoring, some of the methods being tested in a pilot project on the east coast may be incorporated into future west coast monitoring.

CHARLOTTE HARBOR RESEARCH

The District, in collaboration with the Mote Marine Laboratory, has been conducting research needed to understand the effect of river flow on significant ecological resources and processes. The Caloosahatchee River and Estuary (CRE) Collaborative Research Project coincides with a Mote Marine Laboratory five-year study of Charlotte Harbor, funded by the Mote Scientific Foundation and other private and public sources. The research being funded by the District expands Mote Marine Laboratory's study and extends it to the southern harbor.

The objective of the first year of this work was to design the final research plan. This includes reconnaissance, expansion, and refinement of the Caloosahatchee Estuary Conceptual Ecological Model (Barnes, in review), detailed identification of information needs, bibliographic updates and applications, preliminary field sampling and measurement, and development of a first year report. The objective of the overall CRE Collaborative Research Plan is to determine and empirically evaluate causal relationships of river flow to the distribution, abundance, and/or condition of selected valued ecosystem components. The contract was completed in 2005 and a final report is available.

MACRO-BENTHIC MONITORING FOR ST. LUCIE ESTUARY AND SOUTHERN INDIAN RIVER LAGOON

The main objectives of the Macro-Benthic Monitoring Project for St. Lucie Estuary and Southern Indian River Lagoon project are to (1) evaluate the present health status of these water bodies as baseline data, (2) record and follow long-term changes in these ecosystems, (3) attribute causative factors to observed changes (i.e., freshwater runoff/release, natural successions and oscillations, climate change, other anthropogenic impacts), (4) pinpoint and evaluate anthropogenic disturbances, and (5) provide reference data for possible intensive short-term local monitoring programs.

Environmental monitoring determines the chemicals present in an ecosystem, but it does not identify the effects, especially long-term effects, on the ecosystem by those chemicals that are present (Spellerberg, 1994). Therefore, biological monitoring is generally regarded as one of the most effective tools in detecting natural successions/changes and anthropogenic disturbances in the environment, especially in marine systems. Benthic infaunal communities are primarily stationary, and therefore are continuously exposed to changes in the environment; this is in contrast to motile animal communities that can migrate out of an area during times of disturbance, while later returning to the (temporarily) impacted system. This is one of the main reasons why benthic infaunal monitoring is commonly regarded as one of the best tools for evaluating the health and long-term changes within the marine environment. Monitoring began in December 2004.

SOUTHERN INDIAN RIVER LAGOON SEAGRASS AND MACRO-ALGAE MONITORING

Seagrass and macro-algae will be monitored in the Southern Indian River Lagoon near the mouth of the St. Lucie River to document seasonal changes in seagrass and associated macro-algae (epiphytes, attached algae, and drift algae). Data collected will be used to better understand (1) the natural seasonal variability of seagrass and macro-algae in the study area, and (2) the response of the seagrass community to freshwater discharge. Additionally, water quality data will be collected to evaluate potential links between water quality and trends in seagrass and algae.

Seagrasses are a prominent feature of Southern Indian River Lagoon, and are considered to be good indicators of ecosystem health. Seagrass monitoring data provides valuable information for assessing the health of the lagoon and for making water management decisions regarding the impacts of freshwater releases on marine resources. Freshwater releases into the St. Lucie River ultimately discharge over seagrass beds in the Southern Indian River Lagoon.

The dominant seagrass species in the Southern Indian River Lagoon are shoal grass (*Halodule wrightii*) and manatee grass (*Syringodium filiforme*) (Morris et al., 2000). Of these two species, *Syringodium* appears to be the most sensitive to declines in salinity (URS Greiner, Inc., 1999). Monitoring conducted in *Syringodium* dominated beds may provide earlier warning of freshwater and associated nutrient stresses than monitoring conducted in beds dominated by other species. Macro-algae within the seagrass beds will also be evaluated as potential indicators of excess nutrients.

This study will document changes in seagrass percent cover, shoot counts, percent occurrence, species composition, canopy height, and reproductive status at monthly intervals for at least one year. Additionally, density of epiphytes on the seagrass blades, and percent cover and

occurrence of attached and drift macro-algae will be monitored. Salinity, light, and other water quality parameters will be collected within and adjacent to the seagrass beds for evaluating relationships between water quality and seagrass/algae. A summary report of the first three years findings and recommendations for future monitoring is due September 2005.

INDIAN RIVER LAGOON AND LOXAHATCHEE ESTUARY SEAGRASS PHOTOGRAPHY AND MAPPING

Seagrass photography and mapping is performed every other year in the Indian River Lagoon and Loxahatchee Estuary to evaluate the long-term changes in the distribution and abundance of seagrasses. Traditional aerial photography is acquired at the end of the dry season when water clarity is at its best. The photography is then ground-truthed and GIS maps are produced. This mapping is an important way to quickly assess one of the most important estuarine indicators in this region. Aerial photos were obtained in spring 2005.

WATER QUALITY MONITORING IN THE NORTHERN ESTUARIES

Water quality monitoring in the northern estuaries is intended to (1) document and evaluate changes in nutrient and pollutant loads transported to the Caloosahatchee, St. Lucie, and Loxahatchee River estuaries, and the Indian River and Lake Worth lagoons, and (2) document water quality trends of the estuarine and lagoon waters that are anticipated to occur as a result of upstream CERP projects.

Water quality is currently being collected in all of these downstream receiving water bodies as well as at the major coastal salinity structure that are part of the original C&SF Project. An optimization study is underway that will help determine the best, most cost-effective water quality monitoring program. Based on results of that study and concurrent investigations into new technologies, changes to the location, frequency, parameters, and methods of collection will be considered in 2006.

FISHERIES MONITORING IN THE ST. LUCIE ESTUARY AND SOUTHERN INDIAN RIVER LAGOON

A pilot project was initiated in May 2004 to study different methods of fisheries monitoring and help design a long-term monitoring program for fisheries in the St. Lucie Estuary/Southern Indian River Lagoon. Innovative techniques that are presently being used successfully in other estuaries, but have had little use in the northern estuaries, are being evaluated under this 3-month study. Although several technologies were discussed by the multi-agency team that are guiding this study through the RECOVER Northern Estuary Module Team, the two most cost-effective and recently successful techniques involve passive and active acoustic monitoring.

The passive acoustic activity consists of an acoustic transect using a fast boat and hydrophones with recorders stopping at various sites with global positioning system (GPS) coordinates can be used to isolate spawning populations of soniferous species as they are sound producers only during reproduction and egg/larval abundance; therefore, reproductive success, is directly proportional to the decibel level of the calling group. Spawning populations of groupers, spotted seatrout, snook, sheepshead, mojarras, and gobies can be isolated in this manner and placed on spatial/temporal maps.

Another technology being tested uses acoustic tags emitting high frequency signals. This VEMCO acoustic system uses an array of field deployed hydrophones as signal receivers and tag signal recorders. They compile diagnostic tag signals from individual fish that have been surgically implanted with small acoustic tags. The receivers can remain in the field up to 6 months without battery change, but should be examined at least once every two weeks. Data downloads can occur in the field. The tags may remain active for up to three years. Receivers placed at strategic sites in the St. Lucie Estuary and canals could determine the migratory behavior of target species relative to water release from Lake Okeechobee or the north fork of the river.

A likely target species that has interagency interest [Florida Fish and Wildlife Conservation Commission (FWC), National Oceanic and Atmospheric Administration/National Marine Fisheries Service (NOAA/NMFS), and District] would be the snook (*Centropomus undecimalis*), a major top predator in all northern estuaries targeted by RECOVER.

NORTHEAST FLORIDA BAY WATER QUALITY TRENDS

The water quality monitoring program for Florida Bay and the adjacent southwest Florida estuaries and coast is evaluating status, quantifying changes, and documenting trends in water quality as a result of CERP implementation. During Water Year 2004 (WY2004) (May 1, 2003 through April 30, 2004), Florida Bay hydrologic conditions were near long-term averages with regard to rainfall, freshwater flow into the bay, and salinity.

Water quality conditions have undergone a decade-long period of improvement with decreasing concentrations of total nitrogen, total phosphorus, chlorophyll *a*, and decreasing turbidity. In 2004, each of these parameters had values well below the long-term average. Since 1996, a similar trend of decreasing nutrient concentrations in water flowing into the bay also has occurred. During this period, nutrient, and chlorophyll concentrations generally have been highest in the central bay.

SUBMERGED AQUATIC VEGETATION MAPPING IN FLORIDA BAY

Mapping of SAV patches is a critical measurement for estuarine health. Seagrass communities act as habitat for many estuarine species, especially for many fish and invertebrates in their critical larval stages. Therefore, seagrass community composition and spatial extent is an indicator of estuarine productivity.

The Florida Marine Research Institute, under a cooperative agreement with the District, digitized, georectified, and performed patch metric analyses on seagrass photography from the early 1990s, and attempted to take photos in 2003 for comparison. However, murky water conditions limited photographic capabilities during that time. Photography for both Biscayne Bay and Florida Bay was obtained in May 2005; a patch metrics analysis report is due in November 2005. Mapping of Biscayne Bay will be obtained under a separate contract which will be initiated in 2006.

SOUTHERN ESTUARIES SALINITY MONITORING NETWORK

Data gaps were identified within the salinity monitoring networks in Florida Bay. In Florida Bay, meters are being installed at three areas – West Lake, Snake Bight, and Middle Ground – to increase the spatial coverage for salinity monitoring in areas likely to be influenced by CERP

implementation. Additionally, in West Lake, where no previous salinity data was known to exist, quarterly salinity monitoring measurements were collected for the first year of sampling to determine salinity variability throughout this lake.

A pronounced salinity gradient was found from the northeast corner of the lake to the southwest corner. In the northwest corner of the lake, the salinity ranged from 9.10 ppt (June 17, 2004) to 19.40 ppt (March 31, 2005). In the southwest corner of the lake, salinities ranged from 16.90 ppt (January 26, 2005) to 23.20 ppt (March 31, 2005). This is in contrast to historical accounts of West Lake being a primarily freshwater system that supported submergent freshwater vegetation and was a wintering ground for freshwater bird species such as the American coot (*Fulica americana*) (John Ogden, District, personal communication).

2005 Assessment Strategy for the Monitoring and Assessment Plan

In September 2005, the Assessment Team released a final draft of the 2005 Assessment Strategy for the Monitoring and Assessment Plan for review (RECOVER, 2005a). The purpose of this document is to present a clear understanding of the assessment process that replaces the current Section 2.0 of the MAP (RECOVER, 2004b). The document provides guidance to those responsible for conducting the assessment of MAP monitoring information and preparing annual reports on their findings.

RECOVER will periodically issue technical reports on CERP's progress based upon comparisons between the measured performance of the CERP and the performance measures' restoration targets. These technical reports will be consulted and referenced by the USACE and the SFWMD when preparing assessment reports as required by the Programmatic Regulations (DOD, 2003). The technical reports and assessments of key indicators will be the source of information in preparing a proposed CERP Report Card to be issued to the public, stakeholders, and legislators. The paragraphs below describe the Integrative Assessment Guidance Process developed by the Assessment Team and presented in the 2005 Assessment Strategy.

Integrative Assessment Guidance Process

The RECOVER Integrative Assessment Guidance Process establishes a multi-step process for detecting and assessing changes in performance measures, assessing progress toward achieving interim goals and interim targets, and evaluating the status of module and systemwide hypotheses. The guidance is comprised of three sections. The first addresses assessments at the MAP component level (e.g., specific monitoring and supporting research projects), the second at the module level, and the third at the systemwide level. The assessment process applies specifically to the natural system and can be modified, as necessary, to address water supply and flood protection.

MAP COMPONENT-LEVEL GUIDANCE

The MAP component-level guidance is developed within the regional module groups. This level of assessment guidance has three parts: (1) estimating the ability to detect change; (2) establishing reference conditions; and (3) measuring changes from reference condition.

The assessments focus on the following: (1) selecting the analysis tools necessary to measure the magnitude and direction of change in the performance measures; (2) determining whether

changes are consistent with desired trends or targets and MAP hypotheses; and (3) determining if there are indications of unanticipated events that affect desired outcomes.

MODULE-LEVEL GUIDANCE

Module-level analyses focus on the integration of multiple performance measures in the assessment of specific hypotheses. These analyses annually cumulate data for trend analysis. At this level, module groups integrate and interpret annual reports, and evaluate the relevance and utility of non-MAP research and assessment.

Module-level assessments are conducted to determine the direction and magnitude of change in the integrated performance measures and to evaluate whether the changes are consistent with expected responses. If the trends do not correspond with the expected responses, the module groups must provide plausible explanations. Finally, the module groups will evaluate progress towards achieving interim goals and interim targets, identify unexpected results, address episodic events, and integrate relevant project-level monitoring.

SYSTEMWIDE GUIDANCE

The results from the systemwide analysis may result in the need for the Assessment Team and/or RECOVER to address a suite of options. This section of the document provides guidance on the possible decision alternatives that could result from the assessment of individual or multiple performance measures and MAP hypotheses within and across modules.

EVALUATION

PERFORMANCE MEASURE CONSISTENCY REVIEWS AND EVALUATIONS OF ALTERNATIVE PLANS

For all CERP projects, the Programmatic Regulations require that the Evaluation Team conduct (1) a performance measure consistency review and (2) an evaluation of alternative projects for systemwide effects. The team is in the process of refining its standard operation procedures (SOPs) for these processes.

The Evaluation Team has recently conducted performance measure consistency reviews for the C-43 Basin Storage Reservoir Project and the Combined Structural and Operational Plan, which is a non-CERP project. The Evaluation Team has recently conducted evaluations of alternative plans for the following CERP projects: Broward County Water Preserve Areas, Acme Basin B Discharge Project, Winsberg Farms, and Everglades Agricultural Area Storage Reservoirs. The Evaluation Team also conducted an alternative plan review of the Initial CERP Update.

OTHER GUIDANCE DOCUMENTS

In addition to the SOPs discussed in the above section, the Evaluation Team will develop (1) a strategy for the Evaluation Team's interaction with projects and (2) a peer-review process for predictive models. The team has already begun development of the strategy for interacting with projects in coordination with the Assessment and Planning teams.

PERFORMANCE MEASURES

Regional subteams continue to develop and refine the evaluation sections of performance measures. These sections are integrated into a single performance measure containing both assessment and evaluation sections as was described earlier in the document.

The performance measure review process has been modified and timeframes expanded to enable both the Evaluation and Assessment Teams to review and accept the integrated documentation sheets. This process was refined during fall 2005 and will be implemented by the end of year 2005.

EVALUATION TOOLS

The Evaluation Team is finalizing a list of predictive tools needed to develop and use performance measures. These include, but are not limited to, computer models. The need for better documentation of computer model output has also been identified, and the Greater Everglades subteam has begun addressing this issue.

ECOSYSTEM BENEFIT QUANTIFICATION METHODOLOGY

The Evaluation Team will begin the development of an ecosystem benefit quantification methodology to assist with systemwide planning and alternative plan evaluation. Work on this is expected to begin in fall 2005.

PLANNING AND INTEGRATION

INITIAL CERP UPDATE

In Chapter 7 of the 2005 SFER – Volume I, it was reported that an effort known as the Initial CERP Update (ICU) would be a first step in assuring that new technical information is integrated into CERP's implementation. Modeling for the ICU was completed in June 2005. The final report was completed in September 2005.

This report provides an overview of the purposes and background of the ICU; a discussion of the new information, such as tools, performance measures, and data acquired since CERP was completed in 1999; planning assumption updates; results of performance evaluations; and compares the ICU evaluation results to CERP. Technical updates, detailed regional evaluations, Natural System Model targets, and South Florida Water Management Model assumptions and other technical information are also discussed.

The ICU is the first of the periodic reports required by the Programmatic Regulations for CERP and will be used in determining if the goals and purposes of the plan are achieved or if improvements are warranted. The Programmatic Regulations require that future updates be conducted at least every five years.

With the Initial CERP Update coming to a conclusion, follow-on planning efforts include developing an Aquifer Storage and Recovery Contingency Plan, conducting sea level rise

analyses on CERP, and the development of a work plan for implementing Everglades Rain Driven Operations.

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